ABSTRACT

A method for forming low defect density epitaxial layers on lattice-mismatched substrates includes confining dislocations through interactions between the dislocations and the stress field in the epitaxial layer. This method is applicable to any heteroepitaxial material systems with any degree of lattice mismatch. The method includes choosing the desired epilayer and the top substrate layer for epitaxial growth, determining the lattice constant and thermal expansion coefficient of the final epilayer and the top substrate layer, bonding an additional substrate layer under the top substrate layer to form a composite substrate so that the desired epilayer has negative (positive) or zero thermal mismatch to the composite substrate if the lattice mismatch between the epilayer and the top substrate layer is positive (negative), and choosing a buffer layer to be deposited before the desired epilayer which is lattice matched to the epilayer. The chosen buffer layer should have a positive (negative) thermal mismatch to the entire substrate if the lattice mismatch is also positive (negative).